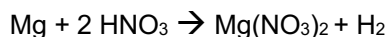


Name: \_\_\_\_\_

Period: \_\_\_\_\_

Seat#: \_\_\_\_\_

- Show work for ANY math problem.
  - Include ALL units on work and answers – missing units = no credit!
  - Use SINGLE DIMENSIONAL ANALYSIS line method set ups for ALL conversions.
  - Put a **BOX** around your final answer.
- 1) A chemical company uses magnesium and nitric acid to make hydrogen gas for customers. A customer ordered 650 L of hydrogen gas. At “standard temperature and pressure” conditions (STP) 1mol of gas will fill 22.4L. We call this conversion factor “molar volume” when at STP conditions. If the company only has 2400 g of magnesium left in their stock room, how many liters of hydrogen gas can they make? Will this be enough to meet the customer’s need?



- 2) The combustion of propane ( $\text{C}_3\text{H}_8$ ) produces 248 kJ of energy *per mole* of propane burned – that can be used as a conversion factor! Write a balanced equation for the combustion of propane. How much heat energy will be released when 1.5 kg of propane are burned?

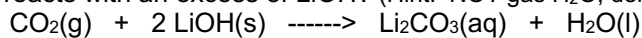
- 3) The human body needs at least  $1.03 \times 10^{-2}$  mol  $\text{O}_2$  every minute. If all of this oxygen is used for the cellular respiration reaction that breaks down glucose, how many grams of glucose does the human body consume each minute?



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- 4) In the space shuttle, the CO<sub>2</sub> that the crew exhales is removed from the air by a reaction within canisters of lithium hydroxide. On average, each astronaut exhales about 20.0 mol of CO<sub>2</sub> daily. What volume of water will be made when this amount of CO<sub>2</sub> reacts with an excess of LiOH? (Hint: NOT gas H<sub>2</sub>O, density of H<sub>2</sub>O is 1.00 g/mL.)



- 5) One step in making para-aminobenzoic acid, PABA, an ingredient in some sunscreens, involves replacing one of the hydrogen atoms in a toluene molecule (C<sub>7</sub>H<sub>8</sub>) with an NO<sub>2</sub> group. Water is also formed. Calculate how many molecules of the nitrotoluene product you can make if you start with 550g of toluene and plenty of nitric acid.

- 6) Aspirin, C<sub>9</sub>H<sub>8</sub>O<sub>4</sub>, is made by the reaction of salicylic acid, C<sub>7</sub>H<sub>6</sub>O<sub>3</sub>, and acetic anhydride, C<sub>4</sub>H<sub>6</sub>O<sub>3</sub>. Acetic acid is also produced in this reaction. How many grams of salicylic acid do you need to make 75.0 grams of aspirin?

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- 7) Cellular respiration occurs in animal cells, a reaction that is essentially the combustion of a sugar called glucose,  $C_6H_{12}O_6$ . If the average human uses 550 liters of oxygen when breathing, how many grams of glucose are used by this process? You can assume this is happening at STP.
- 8) Nitroglycerin,  $C_3H_5(ONO_2)_3$ , was invented in 1846 by an Italian chemist named Ascanio Sobrero. Nitroglycerine contains both an oxidant and a fuel. That means it does not need oxygen to combust! When it detonates without oxygen gas present, it decomposes to form carbon dioxide, water, nitrogen, and oxygen, all in a gaseous state. Every mole of the explosive that decomposes in this way generates a tremendous amount of energy – approximately  $1 \times 10^6$  J per mole of nitroglycerin. If 1.135 kg of nitroglycerin detonates, how much energy is produced by the explosion?
- 9) Sodium hydroxide is a strong, inexpensive base used commonly in many industrial chemical processes. It is manufactured by creating a strong aqueous brine (NaCl) solution and applying an intense electrical current. The sodium ions react with the water to generate sodium hydroxide, hydrogen gas, and chlorine gas. If 2345 g of salt is used, how many moles of the base is able to be made?

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**10)** A single replacement reaction between an element and a compound takes place to create a new element and a new compound.

The two reactants are the following:

- 1<sup>st</sup> reactant: An element with the electron configuration of  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$
- 2<sup>nd</sup> reactant: A compound formed from the following elements:
  - o An alkaline earth metal that has 20 neutrons
  - o And a nonmetal atom that makes a (-3) ion and is present in the compound ammonium sulfide.

If you made  $4.58 \times 10^{25}$  molecules of the product that is a compound, how many grams of the reactant compound did you start with? Assume the metal in your product compound has a (+1) charge.